

and South Amboy in New Jersey, where they form the local base of the Cretaceous group. The clays constitute an important item in the mineral resources of the State. The mollusca found in the Amboy Clays prove them to be of estuarine origin. Compared with European strata it seems probable that they may be regarded as Upper Cretaceous.

156 species of plants are described, and these include 8 ferns, 17 conifers, and 5 cycads, in addition to the many dicotyledonous angiosperms, and a few doubtful forms. No palms are recorded.

GEOLOGY OF THE DENVER BASIN IN COLORADO.¹

In this work the authors describe an area of about one thousand square miles, in the centre of which stands the city of Denver in Colorado. Topographically the area itself forms a kind of basin, but geologically it has been found that the rocks of the Cretaceous system, which occur over a large part of the country, constitute a well-defined syncline which is named the Denver Basin.

The mountain range on the west comprises a crystalline complex of pre-Cambrian rocks, flanked by highly inclined rocks of the age of the Jura-Trias, and these are succeeded with apparent though deceptive conformity by Cretaceous deposits which assume a fairly horizontal position beneath Denver, and are uptilted slightly on the east so as to form the before-mentioned basin.

It is held that considerable portions of the crystalline nucleus of the Rocky Mountains constituted an archipelago of large islands in the Palæozoic seas. Within the area now described no outcrops of Lower Palæozoic rocks are found, but there is good reason to believe that they underlie the later sediments, and are concealed along the Archaean borders by the overlapping Mesozoic and later deposits.

The movements that took place at various intervals subsequently to the early Palæozoic times are briefly indicated. They are complex, and have variously affected the character and distribution of the strata. The present relations of the Jura-Trias and Cretaceous to the crystalline nucleus are not due to a simple vertical upward movement of that core: the structure has rather been produced by tangential compression, the effect of which was to produce a structure somewhat analogous to a vertical upthrust, but as a result of a horizontally rather than of a vertically acting force.

The strata referred to the Trias consist, curiously enough, of brilliant red conglomerates, sandstones and shales, with thin limestones and gypsums in the upper part. They are known as the Wyoming formation, and are overlaid by a series of freshwater marls—the Morrison formation—grouped as Jurassic. This group is also known as the Atlantosaurus clays, from its abundant reptilian remains.

The geology of these and of the succeeding Cretaceous, Tertiary and Pleistocene formations, is exhaustively treated, and there is a full account of the igneous rocks. In the chapter on Economic Geology, coal, fire-clays and other clays, building stones, and artesian wells are dealt with. The coal occurs in the Laramie formation of the Cretaceous. A final chapter is devoted to Palæontology, including some account of the Cretaceous plants, by F. H. Knowlton; and of the Jurassic, Cretaceous, and Tertiary vertebrates, by Prof. O. C. Marsh.

The work is well illustrated with maps, sections and pictorial plates. The "spherical sundering in basalt" is well shown in Plate xiv. Among other plates we have restorations of the Jurassic *Brontosaurus*, *Stegosaurus*, *Camptosaurus*, *Laosaurus*, and *Ceratosaurus*; of Cretaceous Birds and Dinosaurs; of the Tertiary Mammals, *Brontops* and *Entelodon*; and of the Quaternary *Mastodon*.

¹ By S. F. Emmons, Whitman Cross, and G. H. Eldridge. ("Monographs of the U.S. Geological Survey," vol. xxvii. Pp. xvii + 556.)

THE MARQUETTE IRON-BEARING DISTRICT OF MICHIGAN.¹

The Marquette district occupies an area extending from Marquette on Lake Superior westwards to Michigamme, a distance of rather less than forty miles, and with a breadth of from one to over six miles. From the western part of the main area, two arms project for several miles, one known as the Republic trough and one as the Western trough. The district is the oldest important iron-producing area of the Lake Superior region.

The rocks comprise three series, separated by unconformities. These are the Basement Complex or Archaean, the Lower Marquette, and the Upper Marquette; the two latter constituting the Algonkian of the district, and perhaps equivalent to Huronian. The Marquette series is mainly sedimentary, although among the strata are included large masses of igneous rocks. The succession of the series is somewhat obscured by irregularities of deposition, and by inter-Marquette erosion. After the Upper Marquette series was deposited the district was folded, faulted and fractured in a complex fashion, with resultant profound metamorphism.

The greater iron-ore deposits occur in the Negaunee formation, which is from 1000 to 1500 feet thick, and occurs in the Lower Marquette series. Petrographically the formation comprises sideritic slate, ferruginous slate, ferruginous chert, jaspilite, and iron-ore. The ferruginous chert and jaspilite are frequently brecciated. The iron-ores resulted from the concentration of the iron-oxides through the agency of downward percolating waters. These concentration-bodies usually occur upon impervious basements in pitching troughs.

The various features connected with this iron-producing region are all worked out in great detail, and the memoir is beautifully illustrated with coloured plates of banded and brecciated rocks, and various pictorial views and sections.

H. B. W.

ANTHROPOLOGY IN MADRAS.

WHEN recently on furlough in England, I was greatly interested in hunting up the facilities for the study of anthropology in London, and in the scheme for the establishment of a bureau of ethnology for the British Empire. And it has been suggested to me that it may interest those concerned in the development of anthropological research to know what is being done, in a mild way, in a remote possession of the Empire, the Madras Presidency, viz. the southern portion of the Indian peninsula. I add this geographical explanation, inasmuch as a friendly critic, in a recent review of my work, got hopelessly mixed between Madras and Bengal, reminding me of the story of the Viceroy-elect, who was overheard murmuring to himself, "Bombay in the west, Calcutta in the east, Madras in the south." Wide as is the area, and numerous as are the tribes, castes, and races included within my limited beat of 150,000 square miles, I have set myself the task, which must perforce occupy many years, of carrying out a detailed anthropological survey. This survey was, with the approval of the Madras Government, inaugurated in 1894. In that year, equipped with a set of anthropometric instruments obtained on loan from the Asiatic Society of Bengal, I commenced an investigation of the hill-tribes of the Nilgiris, the Todas, Kotas, and Badagas, bringing down on myself the unofficial criticism that "anthropological research at high altitudes is eminently indicated when the thermometer registers 100° in Madras." From this modest beginning have resulted: (1) investigation of the

¹ By C. R. Van Hise and W. S. Bayley, including a chapter on the Republic Trough, by H. Lloyd Smith. ("Monographs of the U.S. Geological Survey," vol. xxvii. Pp. xxvii + 608; 35 plates, and 27 other illustrations, together with large folio atlas of maps.)

various classes which inhabit the city of Madras, during my residence at headquarters; (2) periodical tours to various parts of the Presidency, with a view to the study of the more important tribes and classes; (3) the publication of bulletins, wherein the results of my work are embodied; (4) the establishment of an anthropological laboratory (Fig. 1), equipped with the apparatus necessary for carrying out anthropometric research; apparatus for testing sight, hearing, vital capacity, hand-grip, &c.; a small series of Hindu, Muhammadan, Burmese and Sinhalese skulls; and an anthropomorphic series, still in a very early stage of development, but including the finger-print impressions of an Orang-utan; (5) a collection of photographs of native types, arranged in albums; (6) a series of lantern-slides for lecture purposes.

A museum, such as that of Madras, the visitors to which sign their names in Tamil, Telugu, Kanarese, Malayalam, Nāgari, Hindustani, Mahrāti, Guzarāti, Bengālī, Burmese, Sinhalese, and Chinese, lends itself to the requirements of the anthropologist, as it is resorted to by very large numbers of the poorer classes, who, in return for a small fee, are oftentimes willing to lend their bodies for the purposes of anthropometry. And, nearly every morning, I am to be seen measuring Hindus or Muhammadans, amid an admiring crowd of native visitors (the females dressed in gaudy English piece-goods), in the surrounding corridor. Quite recently, when I was engaged in an inquiry into the Eurasian or half-breed community, the booking for places was almost as keen as on the occasion of a first night at the Lyceum, and the Sepoys of a native infantry regiment, quartered in Madras, entered heartily into the spirit of what they called the "Mujeum gymnashitik shparts," cheering the possessor of the biggest hand-grip, and chaffing those who came to grief over the spirometer. Anthropological research in the city of Madras, where the native community has become accustomed to the European, and discovered that, if his ways are peculiar, he is at any rate harmless, is all plain sailing. But, in the jungles and places remote from civilisation, one has to deal with simple-minded folk, unfamiliar with the eccentricities of the investigator, and suspicious of his motives. Well do I remember a native remarking at a pearl-fishery camp, "Mr. Thurston is a pleasant man, and it is a great pity he is so mad." The fact indicating insanity being that I used to sit outside my tent in the sun, at mid-day in the month of April, examining oyster after oyster in connection with the pearl-producing area.

The essential ingredients of a successful campaign in the wilds are tact, patience, 4-anna pieces, cheap cheerots, and, as a final resource, raw whiskey or brandy. The Paniyan women of the Wynaad, when I appeared in their midst, ran away, believing that I was going to have the finest specimens among them stuffed for the museum. Oh, that this were possible! The difficult problem of obtaining models from the living subject would then be disposed of. The Muppas of Malabar mistook me for a recruiting sergeant, bent on enlisting the strongest of them to fight against the Moplahs. An Irula of the Nilgiris, who was "wanted" for some ancient offence relating to a forest elephant, refused to be measured on the plea that the height-measuring standard was the gallows. A mischievous rumour found credence among the Irulas that I had in my train a

wizard Kurumba, who would bewitch their women and compel me to abduct them. The Malaialis of the Shevaroy's got it into their heads that I was about to annex their lands on behalf of the Crown, and transport them to the penal settlement in the Andaman islands; and one of them informed me that he would rather have his throat cut than be measured. On one occasion I casually photographed a group of Badagas in their bazaar, and, on the following day, a deputation waited on me with a petition to the effect that "we, the undersigned, beg to submit that your honour made 'botos' of us, and have paid us nothing. We, therefore, beg you to do this act of common justice." The deputation was made happy with a *pour boire*. Would that official deputations could be disposed of as easily!

Despite the trifling obstacles at the outset, confidence was eventually established with the various tribes just referred to, though not without a good deal of palavering and mild bribery, and a sufficient number of individuals for statistical purposes were investigated.

The main objects, which are systematically kept in sight during my wanderings, are:—

(1) To record at least the essential measurements of men, and (when they will permit) women.

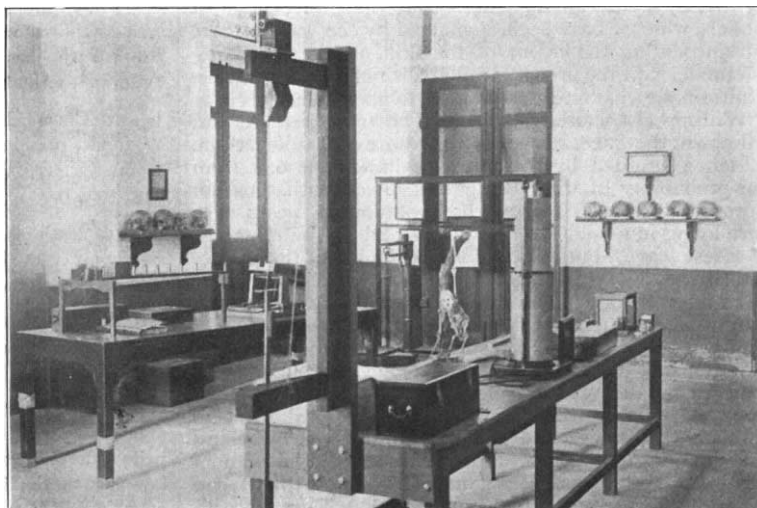


FIG. 1.—Anthropological Laboratory.

- (2) To study the characteristics of external anatomy.
- (3) To record "manners and customs," tattoo-marks, clothing, personal adornment, &c.
- (4) To take photographs of typical individuals, dwelling-huts, &c.
- (5) To acquire by purchase "specimens" illustrating clothing, jewellery, musical instruments, games, &c.

As a general rule the traveller, who makes collections in any branch of science, hands them over, as a gift or by purchase, to some national or provincial museum, and honours are divided; the museum securing the collection, and the collector being immortalised on a label or in a monograph. Possibly, with luck, a new species, or even genus, is named after him, and his reputation is enhanced in the family circle. Looking recently, on a depressing November day such as we in the East know not, at a collection of sponges which to the casual visitor possess no special attraction, exhibited in or by my name at the British Museum (Natural History), I recalled to mind the many pleasant hours spent in a dug-out (canoe) on the coral reefs, an attack by a saw-fish, and a severe sun-head. And the museum, whose destinies I have steered since 1885, teems with happy memories of

camp and jungle life; for, by the fortune of circumstances, it falls within my province not only to make collections, but to preside over their arrangement for exhibition. And the advantages of this dual function are self-evident: a tour concluded, the work of museum arrangement commences; and here one is met with an obvious difficulty at the outset. For two systems of arrangement are possible, each with much to be said both for and against it, and a selection of one or the other has to be made; for the material collected, and available space will not, as a rule, suffice for both. Either the collections may be arranged according to the nature of the exhibit, e.g. models of boats, sacrificial utensils, musical instruments, games, images, &c.; or each tribe or community may be represented in its various aspects, animal and social, in a single case or in adjacent cases. For myself, I give the preference to the latter system, mainly on the score of convenience and finality of arrangement. Very effective, I remember, in one of my galleries, were some life-size photographic transparencies of Andamanese heads, presented by Mr. Portman to the ethnological section of the Indian Museum, Calcutta, when I was in temporary charge thereof some years ago. So, too, were the models of the Andamanese, executed, if my memory serves me rightly, by a Bengali modeller. But the utility of most models, which I have seen, is marred by the want of care in representing the colour of the skin, and in decorating the model with the proper jewellery, which, in many cases, is absolutely characteristic of a particular tribe.

Writing elsewhere, I said: "The more remote and unknown the race or tribe, the more valuable is the evidence afforded by the study of its institutions, from the probability of their being less mixed with those of European origin." Tribes which, only a few years ago, were living in a wild state, clad in a cool and simple garb of forest leaves, buried away in the depths of the jungle, and living, like pigs and bears, on roots, honey, and other forest produce, have now come under the domesticating, and sometimes detrimental influence of contact with Europeans, with a resulting modification of their conditions of life, morality, and even language. The Paniyans of the Wynad and the Irulas, who inhabit the slopes of the Nilgiris, now work regularly for daily wage on planters' estates; and I was lately shocked by seeing a Toda boy studying for the third standard, instead of tending the buffaloes of his "mand." Ample proof can be adduced in support of the fact that European influence, import-trade with other countries, and the struggle for existence, are bringing about a rapid change (sad from an ethnographic standpoint) among the natives of Southern India, both tame and wild. It has recently been said that "there will be plenty of money and people available for anthropological research when there are no more aborigines"; and it behoves our museums in Great Britain and its dependencies to waste no time in completing their anthropological collections.

I gathered from observation when in London (1) that man as a social and intellectual being is illustrated with the unavoidable want of proportion, when no systematic scheme for the regular expansion of the collections is at work at the British Museum, Bloomsbury; (2) that it is under contemplation to illustrate man and the varieties of the human family from a purely animal point of view at the British Museum (Natural History), South Kensington; (3) that skulls must be sought for at the Royal College of Surgeons, Lincoln's Inn Fields; (4) that lectures and anthropological literature are available to members at the Anthropological Institute, Hanover Square. To this must be added (5) Mr. Galton's laboratory. Surely a great want of centralisation, such as might well be remedied, is indicated here. And as I wandered, both in and out of the London season, through the deserted galleries of the Imperial Institute, I could

not refrain from speculating whether, with a radical change of policy for good, this much-discussed building could not be converted into our great National Museum of Ethnology, where man shall be represented fully and in every aspect, and where those interested in ethnological research could find under one roof a skilled staff to appeal to in their amateur difficulties, collections, literature, lectures, and anthropological laboratory. For the great mass of visitors to popular museums, who come under the heading of sightseers, it is of primary importance that the exhibits should be attractive. And I feel convinced that, were an ethnological museum up to the high standard of the British Museum (Natural History) established, it would, when its reputation became known, be, like Madame Tussaud's, widely resorted to by the general public, and that, by an admixture of free and paying days, and by the charge of a small fee for examination in the laboratory, it might be made to a certain extent self-supporting, and not entail a great burthen of expenditure on the State.

EDGAR THURSTON.

Madras Government Museum.

NOTES.

WE are glad to notice that the Queen's birthday honours include the name of Dr. John Murray, F.R.S., of *Challenger* renown, who has been appointed a Knight Commander of the Order of the Bath (K.C.B.).

THE Chemical Society's banquet to Lord Playfair and six other past presidents who have completed fifty years' fellowship of the Society, is to be held at the Hôtel Métropole on Thursday, June 9.

THE death is announced of M. Souillart, professor of astronomy in the University of Lille, and correspondent in the Section of Astronomy of the Paris Academy of Sciences.

THE Department of Science and Art has received information that the fifth International Congress of Hydrology, Climatology, and Geology will be opened at Liège on September 25.

THE eighty-first annual meeting of the Société helvétique des sciences naturelles will be held at Berne on August 1-3. This will be the sixth occasion upon which Berne has been the meeting-place of the Society. The reception will take place in the great hall of the Museum on the evening of Sunday, July 31. On the following day there will be a general meeting, a banquet, and a fête, and the sections will meet for the consideration of papers on August 2. The sections and their presidents are as follows:—Mathematics, astronomy and physics, MM. Graf, Huber, Sidler; chemistry, MM. de Kostanecki, Friedheim; botany, M. L. Fischer; zoology, M. Th. Studer; anthropology, M. Th. Studer; geology, mineralogy, petrography and palæontology, M. A. Baltzer; physical geography (comprising geodesy and meteorology), M. E. Brückner; anatomy and physiology, MM. Strasser and Kronecker; medical clinics, MM. Kocher, Müller, Sahli; hygiene and bacteriology, MM. Girard, Tavel; pharmacy and alimentation, M. Tschirch; veterinary science, M. Berdez; agriculture and sylviculture, M. Coaz.

At the Royal Institution on Thursday, June 2, Dr. Edward E. Klein delivers the first of two lectures on "Modern Methods and their Achievements in Bacteriology," and on Saturday, June 4, Dr. Richard Caton begins a course of two lectures on "The Temples and Ritual of Asklepios at Epidaurus and Athens." The Friday evening discourse on June 3 is by Prof. W. M. Flinders Petrie, on "The Development of the Tomb in Egypt"; that on June 10 is by Lord Rayleigh, whose subject is "Some Experiments with the Telephone."